Patent
Attorney's Docket No. 027557-064

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY PATENT
APPLICATION TRANSMITTAL LETTER

Box PATENT APPLICATION
Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Enclosed for filing is the utility patent application of Johan NILSSON for RADIO TRANSCEIVER.

Also enclosed are:

[X] 1 sheet(s) of [X] formal [ ] informal drawing(s);

[X] a claim for foreign priority under 35 U.S.C. §§ 119 and/or 365 is [ ] hereby made to _ filed in _ on _;

[X] in the declaration;

[ ] a certified copy of the priority document;

[ ] a General Authorization for Petitions for Extensions of Time and Payment of Fees;

[ ] an Assignment document;

[ ] an Information Disclosure Statement; and

[X] Other: Preliminary Amendment.

[X] An [ ] executed [X] unexecuted declaration of the inventor(s)

[X] also is enclosed [ ] will follow.

[X] Please amend the specification by inserting before the first line the sentence --This application claims priority under 35 U.S.C. §§ 119 and/or 365 to 9924033.5 filed in the United Kingdom on October 11, 1999; the entire content of which is hereby incorporated by reference.--

[ ] A bibliographic data entry sheet is enclosed.

[ ] Small entity status is hereby claimed.

[X] The filing fee has been calculated as follows [X] and in accordance with the enclosed preliminary amendment:

CLAIMS					
	NO. OF CLAIMS		EXTRA CLAIMS	RATE	FEE
Basic Application Fee					$710.00 (101)
Total Claims	18	MINUS 20 =	-0-	× $18.00 (103) =	-0-
Independent Claims	4	MINUS 3 =	1	× $80.00 (102) =	80.00
If multiple dependent claims are presented, add $270.00 (104)					---
Total Application Fee					790.00
If small entity status is claimed, subtract 50% of Total Application Fee					---
Add Assignment Recording Fee $ if Assignment document is enclosed					---
TOTAL APPLICATION FEE DUE					**790.00**

[ ] This application is being filed without a filing fee. Issuance of a Notice to File Missing Parts of Application is respectfully requested.

[X] A check in the amount of $ 790.00 is enclosed for the fee due.

[ ] Charge $ _____ to Deposit Account No. 02-4800 for the fee due.

[X] The Commissioner is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

Please address all correspondence concerning the present application to:

Ronald L. Grudziecki
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: October 10, 2000

By: _____
Steven M. du Bois
Registration No. 35,023

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

Patent
Attorney's Docket No. 027557-064

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	)	
	)	
Johan NILSSON	)	Group Art Unit: Unassigned
	)	
Application No.: Unassigned	)	Examiner: Unassigned
	)	
Filed: October 10, 2000	)	
	)	
For: RADIO TRANSCEIVER	)	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE CLAIMS

Please amend claims 9 and 10 as follows:

Claim 9, line 2, delete "one of claims 1 to 8" and insert therefor --claim 1--.

Claim 10, line 2, delete "one of claims 1 to 8" and insert therefor --claim 1--.

REMARKS

The above amendments to the claims have been made in order to eliminate multiple dependencies. Favorable action on the merits of the application is respectfully requested.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: _____

Steven M. du Bois
Registration No. 35,023

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

Date: October 10, 2000

RADIO TRANSCEIVER

TECHNICAL FIELD

This invention relates to radio transceivers, and more particularly to methods of controlling the power at which such transceivers transmit.

BACKGROUND OF THE INVENTION

In a radio communication system, such as a radio telecommunications system having base stations and large numbers of mobile stations which may be in communication with each base station, it is necessary to control the power with which signals are transmitted. For example, it is advantageous to reduce transmit power as far as practicable, but the transmit power must be high enough to provide a required signal level at the receiver. In the case of a direct sequence code division multiple access (DS-CDMA) system, the signals transmitted from the different mobile stations should preferably all be received at the base station at the same level.

Power control is performed by measuring the signal-to-interference ratio (SIR), and controlling the transmit power so that this reaches a target value.

For example, US-5,778,030 describes a spread spectrum communication system, in which a base station sends an adjustment signal to a mobile station, to control the power of transmissions from the mobile station. The adjustment signal is calculated to increase the power level if the received power level is below a threshold, and to decrease the transmit power level if the received power level is above a threshold. The threshold is set at a value which depends on the measured speed of the mobile station.

The paper "SIR-Based Transmit Power Control of Reverse Link for Coherent DS-CDMA Mobile Radio", by Seo, et al, IEICE Trans. Commun. Vol.E81-B, No. 7 July

1998 pp1508-1516, describes an alternative system. In that system, the transmit power of a mobile station is controlled in response to a TPC (transmit power control) signal sent from a base station. The TPC is calculated on the basis of a comparison performed in the base station between, on the one hand, an estimate of the signal-to-interference (SIR) ratio of signals received from the mobile station at the base station and, on the other hand, a target signal-to-interference value. The speed of movement of the mobile station is mentioned as a parameter which has an effect on the optimum size of the steps in which the TPC signal can be controlled.

SUMMARY OF THE INVENTION

A feature of a mobile radio communication system is fading, that is, the variation with time of the quality of a radio channel.

The present invention proceeds from a recognition that, when a mobile station is moving slowly, it is advantageous to control the transmit power thereof to follow, and compensate for, fading of the channel. However, when a mobile station is moving quickly, it will generally not be possible to control the transmit power sufficiently quickly to compensate for a fast fading channel.

According to the present invention, there are provided a radio transceiver, and a method of control thereof, in which a quality measure of received signals, for example the signal-to-interference ratio, is estimated using an algorithm which depends on the measured or estimated velocity of a mobile station.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 is a block schematic diagram of a transceiver according to the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows a transceiver according to one aspect of the present invention, in the form of a mobile station 2, which is in communication with a base station 4. For example, the mobile station may communicate with the base station using a wideband code division multiple access (W-CDMA) system.

As shown in Figure 1, the mobile station 2 includes an antenna 6, and transceiver circuitry 8, which are conventional and well known to the person skilled in the art, and will not be described further herein.

The mobile station 2 also includes a signal-to-interference ratio (SIR) estimator 10, and a velocity estimator 12.

The base station 4 includes an antenna 14, and transceiver circuit 16, which are generally conventional and well known to the person skilled in the art, and will not generally be described further herein.

The SIR estimator 10 of the mobile station 4 is used to control the quality of a signal received from the base station 4. In general terms, if a signal is received at too low a power level, data will be lost. However, it is disadvantageous for transmissions to be made at power levels which are higher than necessary, as this is a potential source of interference.

Thus, as is generally known, the SIR estimator 10 receives pilot symbols and data symbols from the transceiver circuitry 8, and uses them to estimate the signal power and interference power. According to the present invention, however, the SIR estimator 10 uses an estimation algorithm which has a velocity estimate as an input thereto.

Thus, the velocity estimation circuit 12 estimates the velocity of the mobile station 2, for example

estimating its velocity relative to the fixed base station 4 by observing the spreading of the received signals in the frequency domain, as a result of the Doppler effect. More details of one technique for velocity estimation are given for example in US-5,778,030 discussed above. The estimated value of the velocity is then supplied to the SIR estimator 10, and used as an input to the algorithm used therein.

For example, when the mobile station is moving at a low velocity, it becomes possible to follow fast fading of the radio channel. Therefore, it is advantageous to use a fast SIR estimation algorithm. When the mobile station is moving at a high velocity, it is no longer possible to follow fading of the radio channel. Therefore, it is preferable to control a mean value of the signal-to-interference ratio, and so it is advantageous to use a slow SIR estimation algorithm.

For example, the speed of the algorithm, and bandwidth of the estimator, affect the noise properties of the estimate.

SIR estimation algorithms are known to the person skilled in the art, and any suitable algorithms can be chosen in accordance with the invention. For example, the SIR estimator may be able to use both a fast estimation algorithm and a slow estimation algorithm, and may switch between them depending on whether the estimated velocity of the mobile station is below or above a threshold velocity. Alternatively, the SIR estimator may implement an estimation algorithm which uses the estimated velocity of the mobile station as a parameter therein, again to have the effect that, when the mobile station is moving at a low velocity, the SIR estimation algorithm is relatively fast, and, when the mobile station is moving at a high velocity, the SIR estimation algorithm is relatively slow. A suitable

algorithm can be defined by the person skilled in the art.

As mentioned above, the estimated value of the signal-to-interference ratio is compared with a threshold value. The signal-to-interference ratio threshold value is itself set by a control loop which attempts to achieve a desired value of a quality measure of the received signal. For example, the target quality measure could be the bit error rate or frame error rate.

Based on the comparison of the signal-to-interference ratio with the threshold value, a power control signal is sent from the mobile station to the base station 14, and acted upon in the transceiver circuitry 16 of the base station. If the signal-to-interference ratio is lower than the threshold value, a power control signal is sent to increase the transmit power of the base station, and, if the signal-to-interference ratio is higher than the threshold value, a power control signal is sent to decrease the transmit power of the base station.

The invention has been described above in relation to a system in which a mobile station estimates the signal-to-interference ratio of signals received thereby, and then sends a signal to a base station to control the power of transmissions therefrom. It will be appreciated that the invention can be applied also to a system in which a base station estimates the signal-to-interference ratio of signals received from a mobile station using a similar method for estimating the velocity of the mobile station relative to the base station, and then sends a signal to the mobile station to control the power of its transmissions.

The invention has been specifically described with reference to its use in a CDMA system. However, it

will be apparent that the invention can also be used for signal-to-interference ratio estimation, and therefore also for power control if desired, in time division multiple access (TDMA) systems.

There is therefore described a transceiver which allows better control of the transmission powers in a mobile communications system, by adapting the signal quality estimation algorithm to the velocity of movement of the transmitting or receiving mobile station.

CLAIMS

1. A radio transceiver, comprising:

a receiver, for receiving radio signals;

a quality estimator, for estimating a first measure of quality of received radio signals; and

a speed estimator, for obtaining a measure of relative velocity of the transceiver,

wherein the measure of relative velocity is used as an input to the quality estimator.

2. A radio transceiver as claimed in claim 1, wherein the estimated first measure of quality is the signal-to-interference ratio.

3. A radio transceiver as claimed in claim 2, further comprising:

a comparison circuit, for comparing the estimated signal-to-interference ratio with a threshold value thereof; and

a control circuit, for transmitting a power control signal to a further transceiver, based on the result of said comparison.

4. A radio transceiver as claimed in claim 3, wherein the signal-to-interference ratio threshold value is set to achieve a target value of a second measure of quality.

5. A radio transceiver as claimed in claim 4, wherein the second measure of quality is a bit error rate.

6. A radio transceiver as claimed in claim 4, wherein the second measure of quality is a frame error rate.

7. A radio transceiver as claimed in claim 1, wherein the quality estimator uses an estimation algorithm having a response speed, and the response speed of the estimation algorithm is controlled in response to the measure of velocity of the transceiver.

8. A radio transceiver as claimed in claim 7, wherein the response speed of the estimation algorithm is controlled such that a first higher response speed is used in the event of a low measure of velocity of the transceiver, and a second lower response speed is used in the event of a high measure of velocity of the transceiver.

9. A mobile station, including a radio transceiver as claimed in one of claims 1 to 8.

10. A base station, including a radio transceiver as claimed in one of claims 1 to 8.

11. A method of estimating quality of received radio signals in a transceiver, comprising:

obtaining a measure of relative velocity of the transceiver; and

estimating the quality using an estimation algorithm, including using the measure of relative velocity as an input to the estimation algorithm.

12. A method as claimed in claim 11, wherein the estimated measure of quality is the signal-to-interference ratio.

13. A method as claimed in claim 11, wherein the quality estimation algorithm has a response speed, and the response speed of the estimation algorithm is controlled in response to the measure of relative velocity of the transceiver.

14. A method as claimed in claim 13, wherein the response speed of the estimation algorithm is controlled such that a first higher response speed is used in the event of a low measure of velocity of the transceiver, and a second lower response speed is used in the event of a high measure of velocity of the transceiver.

15. A radio receiver, comprising:

a speed estimator, for obtaining a measure of

relative velocity of the receiver, and

a quality estimator, for carrying out an algorithm to obtain a measure of quality of received signals, the being supplied as an input to the quality estimator.

16. A radio receiver as claimed in claim 15, wherein the algorithm is selected on the basis of the measure of relative velocity.

17. A method of estimating quality of radio signals received in a receiver, comprising:

obtaining a measure of relative velocity of the transceiver; and

estimating the quality using an estimation algorithm, including using the measure of relative velocity as an input.

18. A method as claimed in claim 17, comprising using the measure of relative velocity to select an appropriate estimation algorithm.

ABSTRACT

RADIO TRANSCEIVER

A radio transceiver, for example a mobile station for use in a code division multiple access (CDMA) system, estimates the signal-to-interference ratio of received signals, for use in power control of transmissions thereto. The estimation algorithm, used to estimate the signal-to-interference ratio, is altered based on the estimated relative velocity of the transceiver.

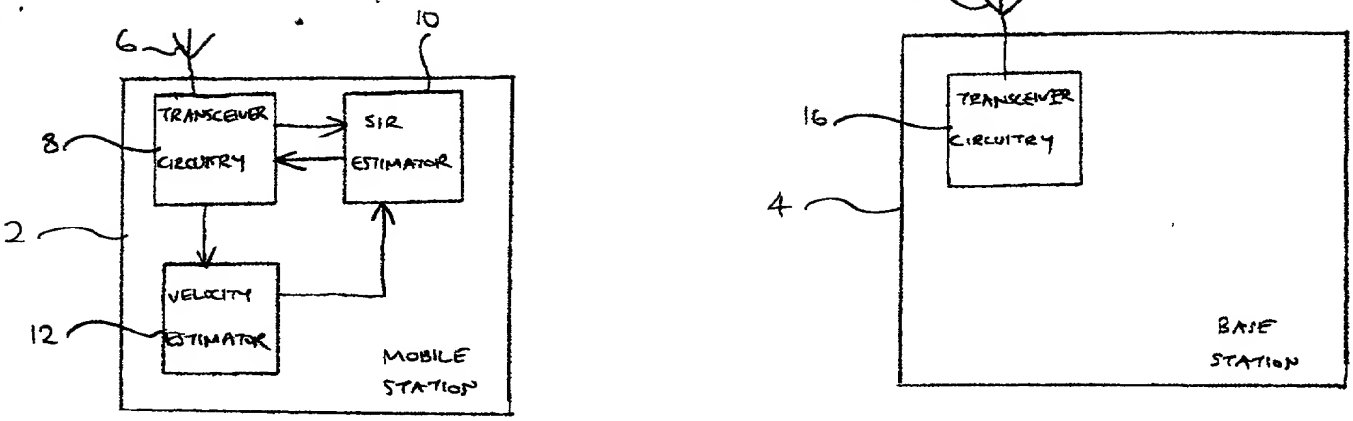
6
10
TRANSCEIVER
CIRCUITRY
SIR
ESTIMATOR
8
2
VELOCITY
ESTIMATOR
12
MOBILE
STATION
14
16
TRANSCEIVER
CIRCUITRY
4
BASE
STATION

FIGURE 1

COMBINED DECLARATION AND POWER OF ATTORNEY FOR UTILITY PATENT APPLICATION	Attorney's Docket No. 027557-064

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I BELIEVE I AM THE ORIGINAL, FIRST AND SOLE INVENTOR (if only one name is listed below) OR AN ORIGINAL, FIRST AND JOINT INVENTOR (if more than one name is listed below) OF THE SUBJECT MATTER WHICH IS CLAIMED AND FOR WHICH A PATENT IS SOUGHT ON THE INVENTION ENTITLED:

RADIO TRANSCEIVER

the specification of which

(check one) ☒ is attached hereto;

☐ was filed on _____ as

Application No. _____

and was amended on _____; (if applicable)

I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS, AS AMENDED BY ANY AMENDMENT REFERRED TO ABOVE;

I ACKNOWLEDGE THE DUTY TO DISCLOSE TO THE OFFICE ALL INFORMATION KNOWN TO ME TO BE MATERIAL TO PATENTABILITY AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, Sec. 1.56 (as amended effective March 16, 1992);

I do not know and do not believe the said invention was ever known or used in the United States of America before my or our invention thereof, or patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to said application; that said invention was not in public use or on sale in the United States of America more than one year prior to said application; that said invention has not been patented or made the subject of an inventor's certificate issued before the date of said application in any country foreign to the United States of America on any application filed by me or my legal representatives or assigns more than twelve months prior to said application;

I hereby claim foreign priority benefits under Title 35, United States Code Sec. 119 and/or Sec. 365 of any foreign application(s) for patent or inventor's certificate as indicated below and have also identified below any foreign application for patent or inventor's certificate on this invention having a filing date before that of the application(s) on which priority is claimed:

COMBINED DECLARATION AND POWER OF ATTORNEY	Attorney's Docket No. 027557-064

COUNTRY/INTERNATIONAL	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED
United Kingdom	9924033.5	11 October 1999	YES X NO_
			YES_ NO_

I hereby appoint the following attorneys and agent(s) to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and to transact all business in connection with international applications directed to said invention:

William L. Mathis	17,337	R. Danny Huntington	27,903	Gerald F. Swiss	30,113
Robert S. Swecker	19,885	Eric H. Weisblatt	30,505	Charles F. Wieland III	33,096
Platon N. Mandros	22,124	James W. Peterson	26,057	Bruce T. Wieder	33,815
Benton S. Duffett, Jr.	22,030	Teresa Stanek Rea	30,427	Todd R. Walters	34,040
Norman H. Stepno	22,716	Robert E. Krebs	25,885	Ronni S. Jillions	31,979
Ronald L. Grudziecki	24,970	William C. Rowland	30,888	Harold R. Brown III	36,341
Frederick G. Michaud, Jr.	26,003	T. Gene Dillahunty	25,423	Allen R. Baum	36,086
Alan E. Kopecki	25,813	Patrick C. Keane	32,858	Steven M. duBois	35,023
Regis E. Slutter	26,999	B. Jefferson Boggs, Jr.	32,344	Brian P. O'Shaughnessy	32,747
Samuel C. Miller, III	27,360	William H. Benz	25,952	Kenneth B. Leffler	36,075
Robert G. Mukai	28,531	Peter K. Skiff	31,917	Fred W. Hathaway	32,236
George A. Hovanec, Jr.	28,223	Richard J. McGrath	29,195		
James A. LaBarre	28,632	Matthew L. Schneider	32,814		
E. Joseph Gess	28,510	Michael G. Savage	32,596		

21839

and: _____

Address all correspondence to:

21839

Ronald L. Grudziecki
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, Virginia 22313-1404

Address all telephone calls to: Steven M. du Bois at (703) 836-6620.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR	SIGNATURE	DATE
Johan NILSSON		
RESIDENCE	CITIZENSHIP	
Malmö, Sweden	Swedish	
POST OFFICE ADDRESS		
Nordlindsväg 94A, S-217 93 Malmö, Sweden		
FULL NAME OF SECOND JOINT INVENTOR, IF ANY	SIGNATURE	DATE
RESIDENCE	CITIZENSHIP	
POST OFFICE ADDRESS		